United States
Department of
Agriculture

**Forest
Service**

Forest
Products
Laboratory

Dividends From Wood Research

Recent Publications
January–June 1995

Explanation and Instructions

"Dividends From Wood Research" is a semiannual listing of recent publications resulting from wood utilization research at the Forest Products Laboratory (FPL). These publications are produced to encourage and facilitate application of Forest Service research. This issue lists publications received from the printer between January 1 and June 30, 1995.

Each publication listed in this brochure is available through at least one of the following sources.

Available from FPL (indicated by an order number before the title of the publication): Quantities limited. Circle the order number on the blank at the end of the brochure and mail or FAX the blank to FPL.

Available through sales outlets (indicated by the name of the outlet and, when available, price information): Major sales outlets are the Superintendent of Documents, the National Technical Information Service (NTIS), and various private publishers. Order directly from the outlet.

Available through libraries: Research publications are available through many public and university libraries in the United States and elsewhere. U.S. Government publications are also available through many Government Depository Libraries. Check with a major library near you to determine availability.

List of Categories

Publications are listed in this brochure within the following general categories:

Biodeterioration and Protection
Engineering Properties and Design Criteria
Fiber and Particle Products
Fire Safety
Microbial and Biochemical Technology
Mycology
Processing of Wood Products
Pulp, Paper, and Packaging
Timber Requirements and Economics
Tropical Wood Utilization
Wood Bonding Systems

Biodeterioration and Protection

Proceedings of the International Research Group on Wood Preservation; 26th annual meeting; 1995 June 11–16; Helsingor, Denmark. The Research Group on Wood Preservation.
Available from IRG Secretariat, Box 5607, S–114 86 Stockholm, Sweden. Cost: about 150 Swedish crowns/item.

Dimensional Lumber Model Demonstrates the Sensitivity of the Particle Capture Immunoassay in Early Detection of Brown-Rot Fungi by Clausen, Carol A.; Ferge, Leslie. Document IRG/WP 95–20058.

Basidiosporogenesis by Brown-Rot Basidiomycetes *in vitro* by Croan, Suki C. Document IRG/WP 95–10126.

Forest Products Laboratory Methodology for Monitoring Decay in Wood Exposed Above Ground by De Groot, Rodney C.; Highley, Terry L. Document IRG/WP 95–20074.

The Long Road to Understanding Brown-Rot Decay—A View From the Ditch by Green, Frederick III; Highley, Terry L. Document IRG/WP 95–10101.

Hydrolysis of Bordered Pits During Colonization of Conifers by Brown-Rot Decay by Green, F. III; Tschernitz, J.; Kuster, T.A.; Highley, T.L. Document IRG/WP 95–10103.

Antagonism of *Gliocladium virens* Against Wood Decay Fungi by Highley, Terry L.; Ferge, Les. Document IRG/WP 95–10102.

Movement of Boron From Fused Boron Rods Implanted in Southern Pine, Douglas Fir, Red Oak, and White Oak Timbers by Highley, Terry L.; Ferge, Les. Document IRG/WP 95–30061.

Trials of New Treatments for Prevention of Kiln Brownstain of White Pine (*Pinus Strobus*) by Schmidt, E.; Christopherson, E.; Highley, T.; Freeman, M. Document IRG/WP 95–30068.

Low Polymer Levels Containing Bioactive Monomer Polymerized *in situ* provide resistance to *Gloeophyllum trabeum* by Ibach, Rebecca E.; Rowell, Roger M. Document IRG /WP/95–30066

1. Fungal Decay Resistance of Loblolly Pine or Sweetgum Reacted With Aqueous Potassium Iodate

Chen, George C.
1995. Wood and Fiber Sci. 27(2): 155–159.

This investigation determined the fungal decay resistance of wood reacted with potassium iodate and studied the reaction of potassium iodate with wood.

2. Dissociation of the Multi-Enzyme Complex of the Brown-Rot Fungus *Postia Placenta*

Clausen, C.A.
1995. FEMS Microbiology Letters. 127: 73–78.

The objective of the study reported here was to dissociate endoglucanase from other polysaccharidases of the brown-rot fungus *P. placenta* and characterize endoglucanses for future studies on the role of the cellulolytic enzymes in the brown-rot decay process.

3. Production of Antibodies to Fungal Endoglucanase in Murine Ascitic Fluid

Clausen, Carol A.
1994. Biotechnol. Tech. 8(10): 739–742.

Antibodies of brown-rot endoglucanases are needed to further characterize fungal endoglucanases, to evaluate their ability to detect colonization of wood by brown-rot fungi and to study endoglucanase interaction with cellulose and role of endoglucanase in cellulose depolymerization. The objective of this study was to produce high titered antibodies to endoglucanase of *P. placenta* with limited quantities of antigen.

4. Basidiosporogenesis by White-Rot Basidiomycetes *in vitro*

Croan, Suki C.
1994. Prepared for 25th annual meeting of the International Research Group on Wood Preservation; 1994 May 29–June 3; Bali, Indonesia. Section 1, Biology. Document IRG/WP 94–10081. 14 p.

The objective of this study was to demonstrate *in vitro* methods that promote carpogenesis and basidiosporogenesis by the white-rot basidiomycetes *Schizophyllum commune* and *Trametes versicolor*.

5. Biological Control of Sapwood-Inhabiting Fungi by Metabolites From *Streptomyces Rimosus*

Croan, Suki C.; Highley, Terry L.
1994. Biodeterior. Res. 4: 243–256.

The purpose of this study was to enhance and accelerate the production of antifungal metabolites from *St. rimosus* to evaluate the effect of the concentrated metabolites on spore germination of sapwood-inhabiting fungi on wood.

Selection and Use of Preservative Treated Wood in Forest Service Recreational Structures

LeBow, Stan T.; Makel, William J.
1995. TEO1A35. Technical Services. 12 p.

Available from William J. Makel, Program Leader, Recreation, San Dimas Technology & Development Program, San Dimas, CA 91773–3198.

This paper is intended for Forest Service personnel. This article gives an overview of preservative systems, aids in understanding the level of risk and status of the science, and provides some guidelines for using the products.

6. Induction of Oxalic Acid by Carbohydrate and Nitrogen Sources in the Brown-Rot Fungus *Postia placenta*

Micales, Jessie A.
1994. Mater. und Org. 28(3): 197–207.

The objective of this study was to study the *in vitro* induction of oxalic acid by various carbon and nitrogen sources in the brown-rot fungus *Postia placenta*.

Engineering Properties and Design Criteria

Manufactured Housing Walls That Provide Satisfactory Moisture Performance in all Climates

Burch, Douglas M.; Saunders, Christopher A.; TenWolde, Anton
1995. NISTIR 5558. Gaithersburg, MD: National Institute of Standards and Technology. 30 p.

Available from Anton TenWolde, Forest Products Laboratory, One Gifford Pinchot Dr., Madison, WI 53705-2398. No charge.

In this study, a detailed computer analysis was conducted to investigate the moisture performance of a current-practice wall and two alternative walls in a cold, a hot and humid climate, and a mixed climate. Analysis revealed that both alternative walls should have satisfactory moisture performance in the three climates considered. Both alternative walls should be permitted under the current rules of the HUD Standards, since both contain an interior vapor retarder.

7. Using Lightweight MPC Wood Trusses in Bridges

Dagher, H.; Caccese, V.; Altimore, F.; Hsu, Y.; Wolfe, R.; Ritter, M.
1995. *In:* Sanayei, Masoud, ed. Restructuring: America and beyond: Proceedings of Structures Congress 13; 1995 April 2–5; Boston, MA. New York: American Society of Civil Engineers: 9–12. Vol. 1.

This paper summarizes the results of a cooperative research effort initiated in 1991 between the University of Maine and the USDA Forest Service, Forest Products Laboratory, to develop timber bridge designs using metal plate connector trusses. The research addressed fatigue, corrosion, and plate 'back-out.'

8. Housing Products From Recycled Wood

Falk, Robert H.
1994. *In:* Sustainable construction: Proceedings of 1st International conference of CIB TG 16; 1994 November 6–9; Tampa, FL: 469–476.

This paper describes potential technologies to develop building products from recycled wood waste, including dry-formed and wet-formed processing, wood/plastic and wood/cement composite manufacture, and solid lumber and timber recycling. Waste resource assessment, product performance evaluation, and standards development, which are necessary to move recycled building products into widespread use, are also discussed.

9. Recycled Lumber and Timber

Falk, Robert H.; Green, David; Lantz, Scott C.; Fix, Michael R.
1995. *In:* Sanayei, Masoud, ed. Restructuring: America and beyond: Proceedings of Structures Congress 13; 1995 April 2–5; Boston, MA. New York: American Society of Civil Engineers: 1065–1068. Vol. 1.

This paper briefly describes opportunities and barriers to the use of recycled lumber and timber in construction. Although significant amounts of "old" timber are available from demolished buildings and other structures, the efficient use of this material is currently limited by lack of appropriate grading rules and engineering design values.

10. Shear and Compression Perpendicular to Grain Property Estimation for 2400f MSR Lumber

Green, David W.; Kretschmann, David E.; Fantozzi, Jeff A.
1994. Forest Prod. J. 44(11/12): 75–81.

The objectives of the Forest Products Laboratory portion of this study were to (1) determine specific gravity, shear strength parallel to the grain (shear), and compression perpendicular to the grain (C-perp) properties of 2400f-2.0E MSR; (2) evaluate shear and modulus of rupture (MOR) relationships used in Eurocode 5; and (3) evaluate relationships between specific gravity (SG) and shear and between SG and C-perp.

11. Energy Criterion for Load Duration Problem in Wood

Liu, Jen Y.; Schaffer, Erwin L.
1995. *In:* Sture, Stein, ed. Engineering mechanics: Proceedings of 10th conference; 1995 May 21–24; Boulder, CO. New York: American Society of Civil Engineers: 1323–1327. Vol. 2.

This paper presents an analysis of time-dependent strength of cellulosic and polymeric materials under ramp loading. The analysis is based on the Reiner–Weissenberg strength theory in conjunction with an Eyring's three-element model. Parameters of the strength model system are evaluated based on existing constant and ramp loading test data of Douglas-fir beams.

12. Wood Bridges in New England

Ritter, Michael A.; Stanfill–McMillan, Kim
1995. *In:* Sanayei, Masoud, ed. Restructuring: America and beyond: Proceedings of Structures Congress 13; 1995

April 2–5; Boston, MA. New York: American Society of Civil Engineers: 1081–1084. Vol. 1.

Wood bridges in New England predate the 18th century. This paper presents an overview of the history, current status, and future of wood bridges in this region. The resurgence of wood bridges is tied to economics, serviceability, and longevity. Research on new bridge designs, which are adaptable to native New England wood species, may improve wood utilization and increase the use of wood bridges.

13. Field Performance of Timber Bridges 2. Cooper Creek Stress-Laminated Deck Bridge

Ritter, Michael A.; Wacker, James P.; Tice, Everett D.
1995. USDA Forest Serv. Res. Pap. FPL–RP–536. 17 p.

The objectives of this project were to design and construct the Cooper Creek bridge and evaluate its field performance for a minimum of 2 years beginning at bridge installation. The project scope included data collection and analysis related to the bridge behavior under static truck loading and general structure performance. The results of this project will be used to formulate recommendations for the design and construction of similar stress-laminated cottonwood bridges in the future.

14. Maintenance Practices for Wood Bridges

Ritter, Michael A.; Williamson, Thomas G.
1995. *In:* Sanayei, Masoud, ed. Restructuring: America and beyond: Proceedings of Structures Congress 13; 1995 April 2–5; Boston, MA. New York: American Society of Civil Engineers: 290–293. Vol. 1.

Proper maintenance is necessary for the continued safe performance of bridges. In times of fiscal constraint, maintenance becomes increasingly important as funding for bridge replacement decreases and existing bridges must continue to safely support traffic loads. Many bridges in our transportation system are made of wood and require specific maintenance unique to wood structures. This paper summarizes several inexpensive maintenance practices for wood bridges, including moisture control, surface treatments, and fumigants.

15. Issues in Crawl Space Design and Construction—A Symposium Summary

Rose, William B.; TenWolde, Anton
1994. ASHRAE Tech. Data Bull. 10(3): 1–4.

At the ASHRAE winter meeting in January 1994 in New Orleans, Louisiana, a symposium entitled "Recommended Practices for Controlling Moisture in Crawl Spaces" was held, jointly sponsored by ASHRAE Technical Committees TC 4.4 and TC 4.9. The aim of this summary paper was to outline the pertinent issues in crawl space construction that were addressed in the eight papers presented at the symposium.

16. Inspection and Evaluation of Structural Members and Connections in the USS Constitution

Soltis, Lawrence A.
1995. *In:* Sanayei, Masoud, ed. Restructuring: America and beyond: Proceedings of Structures Congress 13; 1995 April 2–5; Boston, MA. New York: American Society of Civil Engineers: 489–491. Vol. 1.

The USS Constitution is a national historic treasure that requires constant maintenance and refurbishment. The U.S. Navy recently completed an 18-month drydocking for inspection and repair of the ship. The USDA Forest Service, Forest Products Laboratory, was involved in two aspects of the inspection. The first was to apply the stress wave nondestructive evaluation procedure to determine where and to what extent decay was occurring. The second was to determine why upward deflection (hogging) of the keel was occurring.

17. Factors Influencing Timber Bridge Performance

Stanfill–McMillan, Kim; Kainz, James A.
1995. *In:* Sanayei, Masoud, ed. Restructuring: America and beyond: Proceedings of Structures Congress 13; 1995 April 2–5; Boston, MA. New York: American Society of Civil Engineers: 294–297. Vol. 1.

This paper examines National Bridge Inventory data to determine timber bridge performance as affected by maintenance responsibility and design load. Results indicate that design load has the greatest effect on bridge performance. Bridges have higher performance ratings in areas where maintenance is the combined responsibility of state and county or town agencies.

18. Design Tools

TenWolde, Anton
1994. ASTM. American Society for Testing and Materials. Chapter 11.

There are two fundamental approaches to design for moisture control. One approach focuses on the thermal and moisture properties of the building envelope (exterior walls, roofs, and ceilings) needed to withstand the interior and exterior conditions. The second approach attempts to adjust the indoor climate to the thermal and moisture characteristics of the building envelope. This chapter deals with design tools for the exterior only.

19. Field Performance of Timber Bridges 3. Birchlog Run and Tumbling Rock Run Stress-Laminated Deck Bridges

Wacker, James P.; Ritter, Michael A.
1995. USDA Forest Serv. Res. Pap. FPL–RP–538. 11 p.

This report describes the development, design, construction, and field performance of the Birchlog Run and Tumbling Rock Run bridges on the Monongahela National Forest in West Virginia. The bridges were constructed in June 1990. Both bridges are single-lane, single-span, stress-laminated decks that are approximately 30 ft long and 13 ft wide. This monitoring project is unique in that the two stress-laminated deck bridges are located only 1/2 mile apart and are nearly identical in design, but utilize different wood species. The Birchlog Run bridge is constructed of Southern Pine (softwood) lumber, and the Tumbling Rock Run bridge is constructed of Northern Red Oak (hardwood) lumber. Information sheets on both bridges are given in the Appendices.

20. Effect of Moisture Content on Strength of CCA-Treated Lumber

Winandy, Jerrold E.
1995. Wood Fiber Sci. 27(2): 168–177.

This study examined the influence of moisture content and its interaction with loading rate on the bending strength distributions of waterborne-preservative-treated No. 1 and Better Southern Pine nominal 2- by 4-in. (standard 38- by 89-mm) lumber. The results are used to develop revised wet–use service factor adjustments for CCA-treated lumber.

21. Effects of Fire Retardant Treatments After 18 Months of Exposure at 150°F (66°C)

Winandy, Jerrold E.
1995. USDA Forest Serv. Res. Note FPL–RN–0264. 13 p.

This study examined the rate of strength loss of fire-retardant-treated wood at elevated temperatures for a lengthy duration. Small, clear Southern Pine specimens treated with six different fire retardant chemicals were exposed at 150°F (66°C) and 75 percent relative humidity for up to 18 months.

22. Influence of Time-to-Failure on Strength of CCA-Treated Lumber

Winandy, J.E.
1995. Forest Prod. J. 45(2): 82–85.

This study had two objectives. The first objective was to examine the influence of loading rate on the bending strength distributions of waterborne-preservative-treated No. 1 and Better Southern Pine nominal 2- by 4-inch (38- by 89-mm) lumber at three moisture content levels. The second objective was to develop a load-duration model for CCA-treated lumber that incorporated these results.

23. Preliminary Development of Remedial Treatments for Thermally Degraded Fire-Retardant-Treated Wood

Winandy, Jerrold E.; Schmidt, Elmer L.
1995. Forest Prod. J. 45(2): 51–52.

This preliminary research used a laboratory-model system to prove the concept that simple, inexpensive remedial treatments can be developed. With further work, remedial treatments that inhibit thermally induced degrade of undamaged and semi-damaged fire-retardant-treated plywood roof sheathing and roof-truss lumber may be possible.

24. Lateral and Withdrawal Strength of Nail Connections for Manufactured Housing

Winistorfer, Steve G.; Soltis, Lawrence A.
1994. J. Struct. Eng. 120(12): 3577–3594.

The present study investigated connection properties that involve various combinations of connection characteristics used in the construction of manufactured housing. The variables studied were (1) adhesive coatings on nails; (2) presence of subfloor filler materials between wood members of a connection; (3) hand- versus power-driven nails; (4) two species groups; and (5) two moisture content levels.

25. Dynamic Evaluation of Wood Bridges

Wipf, Terry J.; Ritter, Michael A.; Duwadi, Sheila Rimal
1995. *In:* Sanayei, Masoud, ed. Restructuring: America and beyond: Proceedings of Structures Congress 13; 1995 April 2–5; Boston, MA. New York: American Society of Civil Engineers: 1–4. Vol. 1.

A project to investigate the dynamic behavior of wood bridges was recently initiated by Iowa State University; the USDA Forest Service, Forest Products Laboratory; and the Federal Highway Administration. The first phase of this project will involve the evaluation of stress-laminated bridge decks to determine dynamic characteristics. This paper describes the background, objectives, and research methods for this project.

26. ANSI Pole Standards: Development and Maintenance

Wolfe, Ronald W.; Moody, Russell C.
1994. *In:* Barnes, H.M.; Amburgey, T.L., eds. Proceedings 7314. Proceedings of 1st Southeastern pole conference; 1992 November 8–11; Starkville, MS. Madison, WI: Forest Products Society: 143–149.

This paper is an overview of the standards activity of the American National Standards Institute 05 Committee on Wood Poles. Primary focus is the ANSI 05.1 standard for round poles. The factors addressed by this standard are summarized, and the standard is compared with other standards related to the production and structural use of round timbers.

Fiber and Particle Products

27. Cellulose/Polypropylene Composites: The Use of AKD and ASA Sizes as Compatibilizers

Caulfield, Daniel F.; Koutsky, James A.; Quillen, Daniel T.
1993. *In:* Proceedings of 1st wood fiber-plastic composite conference; Madison, WI and 45th annual meeting of the Forest Products Society; New Orleans, LA. Madison, WI: Forest Products Society: 128–134.

The purpose of this study was to discover what effect treatment of cellulose pulp with alkyl ketene dimer and alkenyl succinic anhydride, in both solution and emulsion form, had on the mechanical properties of cellulose and polypropylene composite sheets made by both air-forming and conventional wet handsheet forming.

28. Adhesive Curing and Bonding: Response to Real Time Conditions

Geimer, Robert L.; Christiansen, Alfred W.
1993. *In:* Adhesives and bonded wood products. Proceedings 4735. Proceedings of symposium; 1991 November 19–21; Seattle, WA. Madison, WI: Forest Products Society: 12–29.

This paper describes steam injection pressing and internal board environments specific to the process. A general outline of a resin characterization program is given along with test results, indicating the potential of this technique to distinguish between resin types.

29. Effect of Resin Type on Properties of Steam–Press–Cured Flakeboards

Hse, Chung–Yun; Geimer, Robert L.; Hsu, W. Ernest; Tang, R.C.
1994. Forest Prod. J. 45(1): 57–62.

30. Effect of Resin Variables on Properties of Steam–Press Cured Flakeboards

Hse, Chung–Yun; Geimer, Robert L.; Hsu, W. Ernest; Tang, R.C.
1994. In: Adhesives and bonded wood products. Proceedings 4735. Proceedings of symposium; 1991 November 19–21; Seattle, WA. Madison, WI: Forest Products Society: 30–44.

The objective of this [29,30] study was to compare the properties of steam-injection pressed flakeboards made from either Southern Pine or white oak, using six different resin adhesives, with control boards pressed in a conventional fashion.

31. Steam-Assisted Hot-Pressing of Construction Plywood

Jokerst, Ronald W.; Geimer, Robert L.
1994. Forest Prod. J. 44(11/12): 34–36.

This study was designed to determine if steam injection pressing used for fiberboard, particleboard, and flakeboard could be adapted to the pressing of plywood.

32. Swelling of Wood. Part 2. Swelling in Organic Liquids

Mantanis, George I.; Young, Raymond A.; Rowell, Roger M.
1994. Holzforschung. 48(6): 480–490.

This work evaluated the influence of a wide variety of solvent factors such as molar volume, hydrogen bonding, basicity, dipole moment, dielectric constant, and surface tension on the rate and maximum swelling of wood in organic solvents.

33. Swelling of Wood. Part 4. A Statistical Model for Prediction of Maximum Swelling of Wood in Organic Liquids

Mantanis, George I.; Young, Raymond A.; Rowell, Roger M.
1995. Wood Fiber Sci. 27(1): 22–24.

A statistical model to predict the maximum extent of the swelling of wood in organic liquids is proposed in this work. Solvent basicity, solvent molecular volume, and density of wood appeared to be the most important parameters in the proposed model.

34. Opportunities for Extending the Wood Resource With Adhesive-Bonded Wood Products

Peterson, Kenneth R.; Youngquist, John A.; Zerbe, John I.; Conner, Anthony H.
1994. *In:* Adhesives and bonded wood products. Proceedings 4735. Proceedings of symposium; 1991 November 19–21; Seattle, WA. Madison, WI: Forest Products Society: 2–10.

This paper discusses how adhesives and bonded products can become increasingly important in the effective use of forest products and help the forest product industry be more competitive in building construction. This progress will require bold steps in research and the application of new technologies.

35. Potentials for Composites From Jute and Allied Fibers

Rowell, R.M.
1994. *In:* Resume of papers presented at international symposium on biocomposites and blends based on jute and allied fibres; UNDP, New Delhi, India. Calcutta, India: Indian Jute Industries' Research Association. 7 p.

This paper describes eight types of composites: (1) geotextiles, (2) filters, (3) sorbents, (4) structural composites, (5) nonstructural composites, (6) molded products, (7) packaging, and (8) combination with other materials. Some of these composites can be made using the whole jute plant and others require fractionation into core and bast fiber.

36. Thermoplasticization of Kenaf and Compatibilization With Other Materials

Rowell, Roger M.; Caulfield, Daniel F.; Sanadi, Anand; O'Dell, Jane
1994. *In:* Proceedings of International Kenaf Association conference; 1994 March 8–10; New Orleans, LA. Ladonia, TX: International Kenaf Association: 1–7.

The purpose of this paper was to present some initial results in the area of kenaf fiber esterification for thermoplasticization to produce kenaf fiber/thermoplastic alloys and kenaf fiber/thermoplastic compatibilized blends.

37. Results of Chemical Modification of Lignocellulosic Fibers for Use in Composites

Rowell, Roger M.; Cleary, Brenda A.; Rowell, Jeffrey S.; Clemons, Craig; Young, Raymond A.

1993. *In:* Wood–fiber/polymer composites: fundamental concepts, processes, and material options: Proceedings of 1st wood fiber–plastic composite conference; Madison, WI and 45th annual meeting of the Forest Products Society; New Orleans, LA. Madison, WI: Forest Products Society: 121–127.

In this study, esterification using either acetic, maleic, or succinic anhydrides was found to reduce equilibrium moisture content in aspen fiber regardless of the anhydride used. Fiberboards made from esterified fiber showed greatly reduced reversible and irreversible thickness swelling. Irreversible swelling was completely eliminated in the case of fiber esterified with maleic and succinic anhydrides.

38. Effects of Recycling on the Properties of Fiberboards Made From Recycled Magazine Paper

Rowell, Roger M.; Lange, Sandra E.
1994. *In:* Proceedings of 2d Pacific Rim bio-based composites symposium; 1994 November 6–9; Vancouver, B.C., Canada. Vancouver, B.C., Canada: University of British Columbia: 270–276.

The purpose of this research was to re-examine the use of magazine paper for fiberboards and to recycle these into asecond generation of boards and determine strength and moisture sorption properties differences between the first and second generation (cycles).

39. Chemical Modification of Agro-Fiber for Thermoplasticization

Rowell, R.M.; O'Dell, J.L.; Rials, T.G.
1994. *In:* Proceedings of 2d Pacific Rim bio-based composites symposium; 1994 November 6–9; Vancouver, B.C., Canada. Vancouver, B.C., Canada: University of British Columbia: 144–152.

This report describes current research to develop a commercial process for producing cellulose reinforced agro-fiber/thermoplastic alloys and fiber/thermoplastic compatibilized blends.

40. Reinforcing Polypropylene With Agricultural Fibers

Sanadi, A.R.; Caulfield, D.F.; Jacobson, R.E.; Rowell, R.M.
1994. Resume of papers presented at international symposium on biocomposites and blends based on jute and allied fibres; UNDP, New Delhi, India. Calcutta, India: Indian Jute Industries' Research Association: 163–167.

41. Kenaf Fibers—Potentially Outstanding Reinforcing Fillers in Thermoplastics!

Sanadi, A.R.; Caulfield, D.F.; Walz, K.; Wieloch, L.; Jacobson, R.E.; Rowell, R.M.
1994. *In:* International Kenaf Association conference proceedings; 1994 March 8–10; New Orleans, LA. Ladonia, TX: International Kenaf Association: 155–160.

In these papers [40, 41], the properties of a 50% (by weight) natural fiber (kenaf)- polypropylene were compared with properties of commercial-filled plastics. The effect of the amount of fibers on the stress–strain behavior of natural fiber-polypropylene composites is also briefly discussed. The advantages of using natural fibers, such as kenaf and jute in commodity plastics, are summarized.

42. Hygroexpansion-Creep Model for Corrugated Fiberboard

Urbanik, Thomas J.
1995. Wood and Fiber Sci. 27(2): 134–140.

The objective of this study was to determine if a characterization of the hygroexpansion of corrugated fiberboard subjected to cyclic relative humidity and compression could be used to predict the mechanosorptive creep response.

43. Swept Sine Humidity Schedule for Testing Cycle Period Effects on Creep

Urbanik, Thomas J.; Lee, Sung K.
1995. Wood Fiber Sci. 27(1): 68–78.

The objective of this study was to propose an experimental relative humidity schedule that can be used to rapidly differentiate among the effects of various relative humidity cycle periods on fiber product creep. A swept sine schedule for quantifying the significance of moisture diffusion on the hygroexpansion and creep response of corrugated fiberboard is introduced. The relevant equations for generating a numerical control signal and characterizing the resulting data are also set forth.

44. Properties of Wood Fiber and Polymer Fiber Composites

Youngquist, John A.; Krzysik, Andrzej M.; Muehl, James H.; Carll, Charles
1993. *In:* Wood–fiber/polymer composites: fundamental concepts, processes, and material options: Proceedings of 1st wood fiber–plastic composite conference; Madison, WI and 45th annual meeting of the Forest Products Society; New Orleans, LA. Madison, WI: Forest Products Society: 79–86.

Little data are available on the physical and mechanical properties of nonwoven air-formed wood fiber and plastic–fiber webs that have been pressed into panels of varying density levels. This study establishes performance properties for panels with densities of 0.4, 0.7, 1.0, and 1.2 g/cm^3 and made from three formulations of wood and synthetic fibers (90% hemlock/10% polyester, 90% hemlock/10% polypropylene, and 80% hemlock/10% polyester/10% phenolic resin).

Fire Safety

45. Ignitability Analysis of Siding Materials Using Modified Protocol for Lift Apparatus

Dietenberger, Mark A
1994. *In:* Fire and materials: Proceedings of 3d International conference; 1994 October 27–28; Crystal City, VA. London, UK: Inter Science Communications Limited: 259–268.

This paper reports on the ignitability of common siding materials that could be exposed to wildland fires. When exposed to brands or fires, structures will experience piloted ignition, which is requisite for sustained ignition involving burn-through and surface flame-spread in various directions. In this study, the Lateral Ignition and Flame Spread Test (LIFT) apparatus was used to test various siding materials (plywoods, softwoods, and vinyl), some of which were painted, humidified, or sawed.

Microbial and Biochemical Technology

46. Comparison of Corn Steep Liquor With Other Nutrients in the Fermentation of D-Xylose by *Pichia stipitis* CBS 6054

Amartey, Samuel; Jeffries, Thomas W.
1994. Biotechnol. Ltrs. 16(2): 211–214.

Results of this study show that a fermentation medium containing corn steep liquor as the sole source of nitrogen, vitamins, and other nutritional requirements compares favorably with several more complex media formulations for the fermentation of xylose to ethanol by *P. stipitis* CBS 6054.

47. Oxidative Degradation of Non-Phenolic Lignin During Lipid Peroxidation by Fungal Manganese Peroxidase

Bao, Wuli; Fukushima, Yaichi; Jensen, Kenneth A. Jr.; Moen, Mark A.; Hammel, Kenneth E.
1994. FEBS Ltrs. 354: 297–300.

Recently, the authors reported that MnP promotes the peroxidation of unsaturated fatty acids and that this system accomplishes the oxidative cleavage of phenanthrene, a polycyclic aromatic hydrocarbon that otherwise resists oxidation by fungal peroxidases. Here, the authors show that the MnP/lipid peroxidation system cleaves a non-phenolic lignin model compound oxidatively, and it depolymerizes both non-phenolic and phenolic lignin.

48. Laccase Component of the *Ceriporiopsis subvermispora* Lignin-Degrading System

Fukushima, Yaichi; Kirk, T. Kent
1995. Appl. Environ. Microbiol. 61(3): 872–876.

In this study, laccase activity in the lignin-degrading fungus *Ceriporiopsis subvermispora* was associated with several proteins in the broth of cultures grown in a defined medium.

49. Establishment of Genetic Linkage by Allele-Specific Polymerase Chain Reaction: Application to the Lignin Peroxidase Gene Family of *Phanerochaete chrysosporium*

Gaskell, Jill; Stewart, Philip; Kersten, Philip J.; Covert, Sarah F.; Reiser, Jakob; Cullen, Daniel
1994. Bio/Technol. 12: 1372–1375.

Determining linkage is problematic for genes lacking easily identifiable phenotypes and for organisms without well-defined genetic recombination systems. *Phanerochaete chrysosporium* with its lignin peroxidase (LiP) gene family typifies these difficulties. This paper describes an experimental approach whereby the segregation of specific alleles is directly monitored during sexual fruiting.

50. Technical Overview of Forest Biotechnology Research in the U.S.

Kirk, T. Kent
1994. *In:* Proceedings of 1994 Biological sciences symposium; 1994 October 3–6; Minneapolis, MN. Atlanta, GA: TAPPI Press: 1–4.

The purpose of this study was to provide a framework in which recent research in forest biotechnology can be viewed as a foundation for subsequent papers in this conference. A schematic depicts the gross biochemical activities of trees and how trees interact with other biological systems and the environment. Also included is the fate of harvested trees, because bioprocessing is playing an increasing role in tree utilization.

51. Biopulping: Seven Years of Consortia Research

Kirk, T. Kent; Akhtar, Masood; Blanchette, Robert A.
1994. *In:* Proceedings of 1994 Biological sciences symposium; 1994 October 3–6; Minneapolis, MN. Atlanta, GA: TAPPI Press: 57–66.

This paper provides an overview and status report of a 7-year research effort conducted under the auspices of two sequential consortia involving the Forest Products Laboratory of the USDA Forest Service, the Universities of Wisconsin and Minnesota, and industry. The ultimate objective of the research is to evaluate the technical feasibility of biopulping, defined here as the treatment of wood with lignin-degrading fungi prior to pulping.

52. Three Native Cellulose-Depolymerizing Endoglucanases From Solid-Substrate Cultures of the Brown Rot Fungus *Meruliporia (Serpula) Incrassata*

Kleman–Leyer, Karen M.; Kirk, T. Kent
1994. Appl. Environ. Microbiol. 60(8): 2839–2845.

The aim of this study was to isolate and characterize cellulose-depolymerizing enzymes from cotton being degraded by *M. incrassata* in solid substrate cultures by using the size-exclusion chromatography method of analysis.

53. Treatment of a Pentachlorophenol- and Creosote-Contaminated Soil Using the Lignin-Degrading Fungus *Phanerochaete sordida:* A Field Demonstration

Lamar, Richard T.; Davis, Mark W.; Dietrich, Diane M.; Glaser, John A.
1994. Soil Biol. Biochem. 26(12): 1603–1611.

The objective of this study was to evaluate the feasibility of large-scale application of fungal bioaugmentation in a field demonstration study. The study was conducted at a former pole treatment facility, the Brookhaven Wood Preserving Inc., located near Brookhaven, Massachusetts. Inoculation with *P. sordida* was compared to amending the soil with sterile inoculum substrate and no treatment.

54. Fungal Degradation of Recalcitrant Nonphenolic Lignin Structures Without Lignin Peroxidase

Srebotnik, Ewald; Jensen, Kenneth A. Jr.; Hammel, Kenneth E.
1994. *In:* Proceedings of National Academy of Science USA; 91: 12794–12797.

Lignin peroxidases (LiPs) are likely catalysts of ligninolysis in many white-rot fungi, because they have the unusual ability to depolymerize the major, recalcitrant, nonphenolic structures of lignin. Some white-rot fungi have been reported to lack LiP when grown on defined medium, but it is not clear whether they exhibit full ligninolytic competence under these conditions. To address this problem, this study compared the abilities of a known LiP producer, *Phanerochaete chrysosporium*, with those of a reported nonproducer, *Ceriporiopsis subvermispora*, to degrade a synthetic lignin with normal phenolic content, a lignin with all phenolic units blocked, and a dimer, 1-(4-ethoxy-3-methoxyphenyl)-2-(2-methoxyphenoxy) propane-1,3-diol, that represents the major nonphenolic structure in lignin.

55. Effects of Environmental Conditions on Production of Xylitol by *Candida boidinii*

Vandeska, E.; Amartey, S.; Kuzmanova, S.; Jeffries, T.
1995. World J. Microbiol. & Biotech. 11(2): 213–218.

The objective of this study was to screen a number of yeasts for even higher xylitol production; *C. boidinii* NRRL Y-17213 was identified as a promising xylitol producer and therefore selected for investigation of the effects of environmental conditions on its xylitol production.

56. High-Efficiency Transformation of *Pichia stipitis* Based on Its *URA3* Gene and a Homologous Autonomous Replication Sequence, *ARS2*

Yang, Vina W.; Marks, Jere A.; Davis, Brian P.; Jeffries, Thomas W.
1994. Appl. Environ. Microbiol. 60(12): 4245–4254.

This paper describes the first high-efficiency transformation system for the xylose-fermenting yeast *Pichia stipitis*. The system includes integrating and autonomously replicating plasmids based on the gene for orotidine-5'-phosphate decarboxylase (*URA3*) and an autonomous replicating sequence (ARS) element (*ARS2*) isolated from *P. stipitis* CBS 6054.

Mycology

57. *Phanerochaete Andreae* Sp. Nov. (Aphyllophorales, Basidiomycotina), From the Canary Islands

Burdsall, Harold H. Jr.; Beltran–Tejera, E.; Rodriguez–Armas, J.L.
1995. Mycotaxon. 54: 295–298.

A new species, *Phanerochaete andreae*, found in the Canary Islands, is described. The species is characterized by broad, mostly encrusted, subicular hyphae, a subhymenium with textura intricata-porrecta, large basidia, and absence of cystidia.

58. The Nuclear Status of the *in vitro* Vegetative Mycelium of *Armillaria mellea*

Darmono, T.W.; Burdsall, H.H. Jr.
1994. *In:* Proceedings of the 8th International conference on root and butt rots; 1993 August 9–16; Wik, Sweden and Haikko, Finland. Uppsala, Sweden: Swedish University of Agricultural Sciences: 512–519.

In this study, laser flow cytometry analyses were done to estimate nuclear DNA content of single protoplasts obtained from secondary mycelium isolates and primary mycelium isolates from which the secondary mycelium isolate was derived.

59. Three Host-Specific *Xylaria* Species

Laessoe, Thomas; Lodge, D. Jean
1994. Mycologia. 86(3): 436–446.

A few *Xylaria* species are thought to be host-restricted, especially those occurring on fruits. Little is known, however, about host specificity of tropical *Xylaria* species growing on leaves and wood. This paper reports on three Neotropical species that are restricted to host plants in the Araliaceae Meliaceae.

60. *Phlebia* Species From Eastern and Southeastern United States

Nakasone, Karen K.; Burdsall, Harold H. Jr.
Mycotaxon. 54: 335–359.

Five species of *Phlebia* (Corticiaceae, Basidiomycotina) with warted or toothed hymenophore and one species with a smooth hymenophore are described and illustrated. Three new species, *Phlebia floridensis, P. nantahaliensis,* and *P. weldenian,* are included, and a new combination, *Phlebia fascicularia*, is proposed. *Phlebia weldeniana* is the new name for the invalidly published *Odontia brunnescens. Radulum vinosum*, an invalid name, is placed in synonymy under *P. fascicularia.*

61. Wood-Decay Basidiomycetes From the State of Bolivar in Southeastern Venezuela

Rodriguez, Carmen; Burdsall, Harold H. Jr.; Volk, Thomas J.
1995. Mycotaxon. 53: 377–389.

This report summarizes information on wood-decay fungi from the Lote Boscoso San Pedro in the state of Bolivar in southeastern Venezuela. Forty-four species are reported, including 12 new to the Venezuelan rainforest. Information is presented on substrate/host relationships, type of rot produced, and geographic distribution of each.

Processing of Wood Products

62. Conditioning Stress Development and Factors That Influence the Prong Test

Fuller, James
1995. USDA Forest Serv. Res. Pap. FPL–RP–537. 6 p.

63. Factors That Influence the Prong Test

Fuller, James; Hart, C.A.
1994. *In:* Proceedings of 4th IUFRO International wood drying conference; 1994; Rotorua, New Zealand: 313–320.

The transverse prong test has been used for many decades to evaluate the degree of drying stresses in lumber, which can be used to assess the duration of conditioning time. However, little work has been directed at the proper procedures or interpretation of the prong test. The objectives of this research [62, 63] were to systematically study factors that influence the prong test, thus providing information to properly interpret prong response.

64. Nondestructive Evaluation of Honeycomb and Surface Checks in Red Oak Lumber

Fuller, James J.; Ross, Robert J.; Dramm, John R.
Forest Prod. J. 45(5): 42–44.

The objective of this study was to determine if speed-of-sound transmission perpendicular to the grain is sensitive to the presence of honeycomb and closed surface checks in red oak lumber.

65. Simulation of Drying in a Batch Lumber Kiln From Single-Board Tests

Milota, Michael R.; Tschernitz, John L.
Drying Technol. 12(8): 2027–2055.

The objective in this work was to create a deterministic model that could predict the final moisture content of lumber in a kiln on a board-by-board basis, given the initial moisture content distribution and drying conditions. The model requires that a drying rate function for the individual boards be determined empirically, rather than from calculation of internal mass transfer.

66. Gas Permeability of Plantation Loblolly Pine

Milota, Michael R.; Tschernitz, John L.; Verrill, Steve P.; Mianowski, Theodore
1995. Wood Fiber Sci. 27(1): 34–40.

The objective of this work was to compare the gas permeability of loblolly pine juvenile and mature sapwood as a function of position in the tree. Samples were selected so that differences in permeability could be compared for earlywood and latewood and permeability in the longtitudinal, radial, and tangential directions.

67. Evaluation of Timber Bridges Using Stress Wave Technology

Pellerin, Roy F.; Ross, Robert J.; Falk, Robert H.; Volny, Norbert J.
1995. *In:* Sanayei, Masoud, ed. Restructuring: America and beyond: Proceedings of Structures Congress 13; 1995 April 2–5; Boston, MA. New York: American Society of Civil Engineers: 277–280. Vol. 1.

The focus of this research was to develop stress wave nondestructive evaluation (NDE) techniques for determination of the in-place properties and strength of timber bridge components. Current inspection procedures for timber bridges is often an art involving visual assessments of the degree of decay and mechanical damage and of the extent to which the deterioration has penetrated into hidden regions of the structure. The NDE techniques utilizing stress waves has successfully been used to improve the assessment of the integrity of wood structures.

68. NDE Techniques for Wood Structures

Ross, Robert J.
1995. *In:* Sanayei, Masoud, ed. Restructuring: America and beyond: Proceedings of Structures Congress 13; 1995 April 2–5; Boston, MA. New York: American Society of Civil Engineers: 469–472. Vol. 1.

Several techniques have been investigated for use in assessing wood members in structures. Pick- or probing-type of tests, sound transmission characteristics, and vibration response have all been investigated for use in evaluating wood structures. This paper reviews the underlying principles that serve as a basis for use of these techniques.

69. Nondestructive Evaluation of Biologically Degraded Wood

Ross, Robert J.; DeGroot, Rodney C.
1994. *In:* Nondestructive characterization of materials 6: Proceedings of the 6th International conference on nondestructive characterization of materials; 1993 June 7–11; Oahu, Hawaii. New York: Plenum Press: 545–550.

70. Technique for Nondestructive Evaluation of Biologically Degraded Wood

Ross, R.J.; DeGroot, R.C.; Nelson, W.J.
1994. Exp. Tech. 18(5): 29–32.

These papers [69, 70] describe the nondestructive evaluation technique that the authors developed and some typical results obtained from the technique, using both sound and degraded wood.

Pulp, Paper, and Packaging

71. Fiber Fractionation as a Method of Improving Handsheet Properties After Repeated Recycling.

Abubakr, Said M.; Scott, Gary M.; Klungness, John H.
Tappi J. 78(5): 123–126.

The objective of this secondary fiber research was to investigate the use of fiber fractionation to increase the utilization of office recovered paper by upgrading the quality of the fiber, thus minimizing the negative effects of recycling.

72. Surface Deterioration of Refiner Plates for Thermomechanical Pulping

Christensen, D.; Abubakr, S.; Jia, Y.; Scholl, M.; Clayton, P.
1994. *In:* Proceedings of 1994 Pulping conference; 1994 November 6–10; San Diego, CA. Atlanta, GA: TAPPI Press: 193–203. Book 1.

In this study, used refiner plates were subjected to scanning electron and optical microscopy examination to characterize the surface damage and generate insights to the deterioration processes. Eight plates of different materials were examined, taken from different refiner types (some primary, some secondary) after 1,000 to 2,000 hours of service.

73. Quantification of Plastic in Pulp Slurries

Davila, Antonio; Doshi, Mahendra; Scott, Gary M.; Klungness, John H.
1994. *In:* Proceedings of 1994 pulping conference; 1994 November 6–10; San Diego, CA. Atlanta, GA: TAPPI Press: 655–657. Book 2.

The conversion of wastepaper is hampered by the presence of plastic contaminates, which are difficult to detect and remove from the recovered stock. The objective of this study was to investigate and compare methods of quantifying the concentration of different plastics in stock samples.

74. Cellulose-Lignin Interactions—A Computational Study

Houtman, Carl J.; Atalla, Rajai H.
1995. Plant Physiol. 107(3): 977–984.

The objective of the present study was to explore, using molecular modeling methods, the modes of association between the monomer or oligomers of coniferyl alcohol and polysaccharide surfaces. The premise underlying the program was that association of lignin precursors with the polysaccharide surfaces may result in some organization of the precursors prior to polymerization, and this in turn could result in influences on the resulting primary structure and the linkage conformations that occur in the polymer.

75. Effect of Fiber Loading on Paper Properties

Klungness, John H.; Tan, Freya; Sykes, Marguerite S.; Abubakr, Said; Eisenwasser, Jacob D.
1995. *In:* TAPPI Proceedings of the 1995 Papermakers conference; 1995 April 23–26; Chicago. Atlanta: TAPPI PRESS: 533–538.

This study examined the effect on paper properties of fiber-loaded calcium carbonate compared with conventionally directly loaded calcium carbonate. Research in this area has developed the basic technology for a process of precipitating and loading calcium carbonate within and on papermaking fibers.

76. Feasibility of Using Kenaf Chemithermomechanical Pulp in Printing and Writing Paper

Myers, Gary C.; Bagby, Marvin O.
1995. Tappi J. 78(5): 156–161.

To conserve wood resources, kenaf (*Hibiscus cannabinus L.*), a nonwood-fiber plant, can be substituted for wood in pulping. In this study, the objective was to determine if high-yield kenaf mechanical pulp could be used by itself in printing and writing paper.

77. Suitability of Kenaf CTMP for Linerboard

Myers, Gary C.; Bagby, Marvin O.
1994. Tappi J. 77(12): 113–118.

For this study, the Forest Products Laboratory, Cooperative States Research Service, and Agricultural Research Service entered a cooperative agreement to determine how much high-yield kenaf mechanical pulp could substitute for kraft softwood pulp in linerboard. The mechanical pulps used in this study came from two locations. There was an initial, experimental pulping trial at the Andritz Sprout–Bauer Research and Development Laboratory using commercial-scale equipment. The Forest Products Laboratory conducted the other experimental pulping trials using a 305-mm pressurized refiner. This paper presents and discusses the results from both locations.

78. Mild Kraft Treatment of Linerboard Corrugated Medium, and Box Plant Clippings

Reichert, Thomas; McKean, William T.; Abubakr, Said M.
1995. *In:* 1995 Recycling symposium proceedings. Atlanta, GA: TAPPI PRESS: 125–129.

This report describes the separate pulping responses of box plant clippings, linerboard, and corrugated medium. Conditions were selected to reach kappa numbers of processed pulp in the range 40 to 70. Physical properties of the resulting pulps are discussed.

79. Drying Effects of Secondary Fiber on Papermachine Runnability

Rutledge–Cropsey, Kathie R.; Abubakr, Said; Klungness, John H.
1995. *In:* TAPPI Proceedings of the 1995 Papermakers conference; 1995 April 23–26; Chicago. Atlanta: TAPPI PRESS: 311–317.

This study investigated the effect of drying on the runnability of a mixture of bleached hardwood and softwood pulps. In addition, an enzyme was used to enhance drainage of the once-dried fiber. Three paper machine runs were made, and all pulps were refined to the same freeness before papermaking. Never-dried pulp was used in the first run. Dried product from the first run was used for the furnish in the next two runs, one of which was treated with enzymes prior to papermaking and the other was not treated (control).

80. Bio-Refiner Mechanical Pulping of Bast Type Fibers

Sabharwal, Harmohinder S.; Akhtar, Masood; Blanchette, Robert A.; Young, Raymond A.
1995. *In:* 1994 Pulping conference proceedings; 1994 November 6–10; San Diego, CA. Atlanta, GA: TAPPI PRESS: 623–641. Book 2.

In this study, atmospheric refiner mechanical pulping (RMP) and bio-refiner mechanical pulping (BRMP) of kenaf and jute bast were initiated to evaluate an alternate environmentally benign pulping approach.

81. Mechanical Properties of Gridcore™ Panels (FPL Spaceboard) Made From Compositions of Recycled Corrugated, Newsprint and Kenaf

Scott, C. Tim; Newburn, Tim; Hunt, John F.; Herdt, Julee; Jessop, Colin
1995. *In:* 1995 Recycling symposium proceedings. Atlanta, GA: TAPPI PRESS: 345–351.

This paper describes our initial efforts at producing GRIDCORE™ panels from blends of old corrugated containers (OCC), old newsprint (ONP), and kenaf. The panels were tested for edge crush strength, flat crush strength, bending strength, and dimensional stability. The results indicate that desirable mechanical properties can be achieved from all panel compositions.

82. Distribution Modelling of Stock Preparation Systems for Recycled Fibers

Scott, Gary M.
1995. *In:* 1995 Recycling symposium proceedings. Atlanta, GA: TAPPI PRESS: 327–334.

Stock preparation systems for recycled papers need to be designed to produce a high quality, uniform product from a source that has significantly varying properties. Process models are a useful tool for analyzing and optimizing stock preparation systems. However, many models only account for the bulk flow of the components in the form of the fraction of fibers, contaminants, and ash. This report extends some of these modelling ideas to include component distributions.

83. Semiannual Patents Review—January – June 1994

Scott, Gary M.; Abubakr, Said
1994. Prog. in Pap. Recycl. 4(1): 65–70.

Progress in Paper Recycling regularly publishes a review of patents that have been granted in the paper recycling area during a 6-month period. For the most part, the recycling patents listed in this paper have been granted to chemical and equipment companies. The review for January–June 1994 features many new deinking chemicals. It also includes two patents that involve products designed to make paper recycling easier.

84. Environmental Aspects of Biosulfite Pulping

Scott, Gary M.; Lentz, Michael; Akhtar, Masood; Sykes, Marguerite; Abubakr, Said
1995. *In:* Proceedings of the 1995 International environmental conference; 1995 May 7–10; Atlanta, GA: TAPPI PRESS: 1155–1161. Book 2.

This study examined the effect of fungal pretreatment of wood chips prior to sodium- and calcium-based sulfite pulping. The pretreatment involved a 2-week incubation of loblolly pine chips with two strains (CZ-3 and L-14807 SS-3) of the white-rot fungus *Ceriporiopsis subvermispora*. Focus was on the kappa number and yield, effluent quality, and pulp bleachability after pulping.

85. Sludge Characteristics and Disposal Alternatives for the Pulp and Paper Industry

Scott, Gary M.; Smith, Amy; Abubakr, Said
1995. *In:* Proceedings of the 1995 International environmental conference; 1995 May 7–10; Atlanta, GA. Atlanta, GA: TAPPI PRESS: 269–279.

Waste handling is a concern in all pulp and paper mills. It is especially important in mills where secondary fiber is used. Sludge composition, separation, treatment, and disposal methods need to be addressed. This paper explores the composition of sludge resulting from the pulp and papermaking process and compares secondary-fiber and virgin-fiber operations.

86. Sludge Characteristics and Disposal Alternatives for Recycled Fiber Plants

Scott, Gary M.; Smith, Amy; Abubakr, Said
1995. *In:* 1995 Recycling symposium proceedings. Atlanta, GA: TAPPI PRESS: 239–249.

This study explored the composition of sludge resulting from the pulp and papermaking process and compared secondary-fiber and virgin-fiber operations. The residue from separate operations was characterized, indicating the composition of various waste streams. Alternative disposal methods are discussed in reference to these characteristics. Thus, the final sludge use can be based on its characterization, resulting in more efficient use of the residue.

87. The Influence of Clay Addition on Flotation Deinking

Shen, Jie 'Fred'; Abubakr, Said; Springer, Allan M.
1995. *In:* 1995 Recycling symposium proceedings. Atlanta, GA: TAPPI PRESS: 257–267.

Fiber loss is a major concern in deinking operations. In the current laboratory investigation, ledger grade paper underwent a laboratory deinking process that included alkaline pulping, screen washing, and dispersed air flotation. High levels of clay added into the flotation cell significantly decreased the fiber loss in the flotation rejects. Yet, the clay added did not interfere with flotation deinking performance as measured by brightness, dirt count, and Effective Residual Ink Concentration.

88. Effect of Defibration Prior to Peroxymonosulfate Pulping and Transition Metal Content of Fiberized Wood on Pulp Strength

Springer, Edward L.
1994. *In:* Proceedings of 1994 Pulping conference; 1994 November 6–10; San Diego, CA. Atlanta, GA: TAPPI Press: 543–551. Book 2.

In this study, the tensile and tear strength properties of pulps produced by peroxymonosulfuric acid delignification of aspen fiber were compared with those of a pulp produced by peroxymonosulfuric acid delignification of alkaline-pretreated aspen chips. Even after acid pretreatment to remove trace transition metals from the fibers before pulping, the fiber pulps were weaker in tensile strength than the chip pulp. However, the acid-pretreated fiber pulps were stronger in tearing strength than the chip pulp.

89. Environmentally Sound Alternatives for Upgrading Mixed Office Waste

Sykes, Marguerite; Klungness, John; Tan, Freya; Abubakr, Said
1995. *In:* Proceedings of the 1995 International environmental conference; 1995 May 7–10; Atlanta, GA. Atlanta, GA: TAPPI PRESS: 445–448.

This paper describes two complementary alternatives used by researchers at the Forest Products Laboratory to upgrade office waste paper: enzyme-enhanced deinking and fiber loading. These new methods are environmentally compatible, affordable, and use equipment typically available in deinking mills.

90. Enzymatic Deinking of Sorted Mixed Office Waste: Recommendations for Scale-Up

Sykes, Marguerite; Klungness, John; Jeffries, Thomas; Cropsey, Kathleen; Abubakr, Said
1995. *In:* 1995 Recycling symposium proceedings. Atlanta, GA: TAPPI PRESS: 61–64.

The study reported here summarizes results of experiments statistically designed to optimize controllable process variables that affect ink removal. Conditions and equipment similar to those available in deinking mills were used. Several enzyme sources, levels of enzyme addition, pulping consistency, pH, surfactant brand and addition level, and process conditions were investigated. Laboratory procedure was modified to accomodate mill process times, and the possible effects of these changes on pulp properties were examined. These findings formed the basis for recommendations for industrial-scale deinking.

91. Deinking of Flexographic Newsprint: Use of Ultrafiltration to Close the Water Loop

Upton, Bradley H.; Krishnagopalan, Gopal A.; Abubakr, Said
1995. *In:* Proceedings of the 1995 International environmental conference; 1995 May 7–10; Atlanta, GA. Atlanta, GA: TAPPI PRESS: 869–881. Book 2.

This study focuses on the feasibility of ultrafiltration techniques to remove dispersed water-based pigments from aqueous dispersions. An ultrafiltration apparatus was assembled and used to characterize the clarification of flexographic ink dispersions prepared from two commercially available water-based flexographic inks. The efficiency of the ultrafiltration separation process is characterized by parameters such as permeate flux, fouling rate, and cleaning requirements.

92. Effect of Hemicellulases on Unbleached Softwood Kraft Pulp

Yu, X.; Minor, J.L.; Atalla, R.H.; Labbauf, M.M.; Farrell, R.L.
1994. *In:* Proceedings of 1994 International pulp bleaching conference; 1994 June 13–16; Vancouver, B.C., Canada. Montreal, Quebec, Canada: Canada Pulp and Paper Association: 63–67.

To determine the effect of xylanase and mannanase on kraft pulp, the study reported here used classical microscopy stain methods combined with chemical composition analyses and other physical techniques. The chemical and physical interpretation of the stain results was investigated.

Timber Requirements and Economics

93. The Role of Markets and Technology in Conservation of Timber Resources

Ince, Peter J.; McKeever, David B.; Haynes, Richard W.
1995. *In:* Proceedings of the 1995 International environmental conference; 1995 May 7–10; Atlanta, GA. Atlanta, GA: TAPPI PRESS: 315–325.

This report discusses the synergistic role of markets and technology in conservation of timber resources. Different technologies usually require different quantities and types of wood or wood fiber inputs. Such technologies often compete with one another in the same product or end-use arena. In some cases, one competing technology can be regarded as timber-conserving relative to another. Examples include recycled versus virgin-fiber newsprint, steel framing versus wood framing, and oriented strand board versus softwood plywood.

94. A Hierarchical Model for Technological Assessment of the Economic Feasibility of New Forest Products and Processes

Marcin, Thomas C.
1994. *In:* Paredes V., Gonzalo L., ed. Proceedings of international symposium on systems analysis and management decision in forestry; 1993 March 9–11; Valdivia, Chile. Valdivia, Chile: 207–214.

Hierarchical systems consist of a large number of subsystems that are connected in such a way that they can be related in a set of hierarchical structure of layers or levels. The goals or objectives of the system are related in a set of multi-objective functions that are often noncommensurable. The hierarchical process of approaching a problem contains many important attributes for modeling and optimzation. This paper concentrates on strategic planning as part of the hierarchical planning process.

95. Wood Products Used in New Single-Family House Construction: 1950–1992

McKeever, David B.; Phelps, Robert B.
1994. Forest Prod. J. 44(11/12): 66–74.

Studies to quantify wood products consumption for new residential construction have been conducted over the years by the USDA Forest Service and others to provide information needed by government and industry to effectively manage the nation's timber resource and provide needed wood products. This study evaluates consumption estimates made by the Forest Service in 1959, 1962, 1968, and 1988; develops estimates of lumber and wood panel consumption for single-family residential construction from 1950 through 1992; and compares these estimates with those reported in the most recent Forest Service timber assessment research report.

Tropical Wood Utilization

96. Nutrient Cycling by Fungi in Wet Tropical Forests

Lodge, D. Jean
1993. *In:* Isaac, S.; Frankland, J.C.; Watling, R.; Whalley, A.J.S., eds. Aspects of tropical mycology. Proceedings of symposium of the British Mycological Society; 1992 April; University of Liverpool. Cambridge, Great Britain: British Mycological Society. Chapter 3.

In this chapter, data on fungal and microbial biomass and nutrient contents, mostly from wet tropical forests, are compared. The tightness of nutrient cycling in wet and seasonally wet tropical forests is also discussed but with the emphasis on the role of saprotrophic rather than mycorrhizal fungi.

Wood Bonding Systems

97. Synthesis of Difurfuryl Diamines by the Acidic Condensation of Furfurylamine With Aldehydes and Their Mechanism of Formation

Holfinger, Michael S.; Conner, Anthony H.; Holm, David R.; Hill, Charles G. Jr.
1995. J. Org. Chem. 60: 1595–1598.

This paper describes a direct preparation of difurfuryl diamines by the reaction of stoichiometric quantities (2:1) of furfurylamine and an aldehyde in 2.5–5.2 M hydrochloric acid at temperatures from 20°C to 50°C. For the reactions of furfurylamine with formaldehyde and acetaldehyde, the putative intermediate 5-(hydroxy-alkyl)furfurylamines were isolated and identified.

98. Bonding Mechanisms Between Polypropylene and Wood: Coupling Agent and Crystallinity Effects

Kolosick, Paul C.; Myers, George E.; Koutsky, James A.
1993. *In:* Wood-fiber/polymer composites: fundamental concepts, processes, and material options: Proceedings of 1st wood fiber-plastic composite conference; Madison, WI and 45th annual meeting of the Forest Products Society; New Orleans, LA. Madison, WI: Forest Products Society: 15–19.

This paper details part of a continuing investigation into the adhesion between lignocellulosic materials and polyolefins and the influence of that adhesion on the behavior of composites made from lignocellulosics and polyolefins. The specific objective of this phase was to determine the adhesion mechanism between polypropylene and lignocellulosic materials and the effect thereon of emulsified Epolene E-43, a maleated polypropylene wax.

99. Wood Flour and Polypropylene or High-Density Polyethylene Composites: Influence of Maleated Polypropylene Concentration and Extrusion Temperature on Properties

Myers, G.E.; Chahyadi, I.S.; Gonzalez, Carlos; Coberly, C.A.
1993. *In:* Wood-fiber/polymer composites: fundamental concepts, processes, and material options: Proceedings of 1st wood fiber-plastic composite conference; Madison, WI and 45th annual meeting of the Forest Products Society; New Orleans, LA. Madison, WI: Forest Products Society: 49–56.

This paper reports the results of a follow-up investigation to determine the effects of different Epolene E-43 concentrations and extrusion temperatures on the mechanical properties of wood flour–polypropylene composites. The results have implications for balancing the mechanical property mix against the added costs of higher E-43 levels and extrusion temperatures.

100. Outdoor Aging of Wood-Based Panels and Correlation With Laboratory Aging

River, Bryan H.
1994. Forest Prod. J. 44(11/12): 55–65.

This report describes the performance of several phenolic-bonded panels made with veneers, flakes, strands, particles, or fibers after weathering for up to 12 years. The report also compares the performance of these panels to that of the same materials exposed to accelerated aging in the laboratory.

101. Resol Resins Prepared With Tannin Liquified in Phenol

Santana, Marcos A.E.; Baumann, Melissa G.D.; Conner, Anthony H.
1995. Holzforschung. 49(2): 146–152.

This study investigated the possibility of liquefying wattle tannin in phenol to produce modified tannin-formaldehyde adhesives with longer shelf life and better gluability for Southern Pine, the predominant United States plywood species. Unmodified tannin was reacted with phenol in the presence of an acid catalyst. The reaction product was used to prepare phenol-formaldehyde adhesives that were used to bond Southern Pine plywood.

102. Coupling Agent Improves Durability of PRF Bonds to CCA-Treated Southern Pine

Vick, Charles B.
1995. Forest Prod. J. 45(3): 78–84.

The purpose of this report is to describe the nature and apparent mechanism of the new hydroxymethylated resorcinol coupling agent and demonstrate its ability to enhance the durability of adhesion of commercially important phenol-resorcinol-formaldehyde adhesives in CCA-treated Southern Pine lumber laminates.

103. Preliminary Findings on Adhesive Bonding of CCA-Treated Southern Pine

Vick, Charles B.
1994. *In:* Adhesives and bonded wood products. Proceedings 4735. Proceedings of symposium; 1991 November 19–21; Seattle, WA. Madison, WI: Forest Products Society: 158–176.

This report describes the physical and chemical nature of the surfaces of CCA-treated Southern Pine and the effect of these characteristics on adhesion.

104. Hydroxymethylated Resorcinol Coupling Agent for Enhanced Durability of Bisphenol-A Epoxy Bonds to Sitka Spruce

Vick, Charles B.; Richter, Klaus; River, Bryan H.; Fried, Albert R. Jr.
1995. Wood Fiber Sci. 27(1): 2–12.

This report describes the nature and mechanism of bonding of this new coupling agent and demonstrates its ability to enhance the durability of bonds of epoxy adhesives to Sitka spruce.

105. Differential Scanning Calorimetry of the Effects of Temperature and Humidity on Phenol-Formaldehyde Resin Cure

Wang, X.-M.; Riedl, B.; Christiansen, A.W.; Geimer, R.L.
1994. Polymer. 35(26): 5685–5692.

Phenol-formaldehyde resin is a widely used adhesive in the manufacture of wood composites. However, curing behavior of the resin under various environmental conditions is not well known. A differential scanning calorimeter was used to characterize the degree of resin cure in this study.

Special Item

Improving Recovery in Sawing Logs of the Future

Lunstrum, Stanford J.
1994. USDA Forest Service. 20 p.

Available from Forest Products Laboratory, Forest Products Conservation & Recycling Technology Marketing Unit, One Gifford Pinchot Drive, Madison, WI 53705–2398; (608) 231–9352.

This paper describes how shifting our lumber manufacturing paradigm can result in increased lumber recovery from our log resource. With today's technology and knowledge, we can recover 70 percent or more of our log resource in solid wood products. Higher recovery in primary processing requires the application of current technologies with sound, fundamental principles that, in most cases, have already been considered in the past but not successfully applied.

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